Maryland Energy Outlook

Energy Demand and Supply Information

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1.0 EXECUTIVE SUMMARY

This document provides energy demand and supply data and information for the years 2009 to 2018, for different fuels and energy sectors in Maryland. This information is intended as reference material for the *Maryland Energy Outlook* (MEO), to be published by the Maryland Energy Administration in December 2009.

Data is drawn from the following primary sources:

- Public Service Commission (PSC) of Maryland, *Ten-Year Plan (2008-2017) of Electric Companies in Maryland, 2009*
- Public Service Commission (PSC) of Maryland, Case Number 9149, Order No. 82511, "Gap RFP"
- Public Service Commission (PSC) of Maryland, *Analysis of Resource and Policy Options for Maryland's Energy Future,* Levitan & Associates, December 1, 2008
- Public Service Commission (PSC) of Maryland, *BGE EmPOWER MD Staff Initial Comments, 2009*
- U.S. Department of Energy, Energy Information Administration (EIA), *Annual Energy Outlook, State Energy Data 2007*
- PJM , *PJM Load Forecast Report,* January 2009
- American Council for an Energy-Efficient Economy , *Energy Efficiency: The First Fuel for a Clean Energy Future, 2008*
- Maryland Department of Natural Resources, Power Plant Research Program, *Maryland Power Plants and the Environment: A Review of the Impacts of Power Plants and Transmission Lines on Maryland's Natural Resources (CEIR-14), 2008*
- Maryland Commission on Climate Change, *Maryland Climate Action Plan, 2009*

While some of the data contained in this report is not as recent as would be preferred, for the purposes of this report, the data and information is considered to be representative of Maryland's energy demand and supply picture. In addition, electric data drawn from PSC sources reflects end of year 2008 information and does not reflect current economic conditions or recent information updates that are not publicly available.

Current and potential future energy use requires identification and analysis of energy use in Maryland. This report discusses demand in three major categories: direct use, transportation, and electricity. The direct use portion of this report includes all energy not used for transportation or in the generation of electricity. For example, much direct use energy is used for residential heating or direct-fueled industrial processes. The fuels included in this category include natural gas, coal, petroleum and biomass. Direct use of energy accounts for 21% of total Maryland energy demand.

Transportation fuels are discussed in the second section of this report. Transportation fuel use represents 32% of all energy used in Maryland and includes petroleum fuels such as gasoline and diesel along with some natural gas, propane, biodiesel and ethanol.

The last major segment of this report covers electricity generation and use. Generation of electricity consumes 47%, or nearly half of all the energy consumed in the State. The majority of this energy or over 88% is derived from coal and nuclear fuel resources. As noted by the Maryland Public Service Commission (PSC), expected growth in peak demand and electricity use from 2009 to 2018 is due to expected population growth and economic activity, although the current economic recession has lessened the expected gap between future demand and supply in Maryland. Other key variables that drive growth in peak demand and electricity use include energy efficiency programs deployed by utilities, state agencies, and non-governmental organizations, general employment levels, energy prices, population, weather, new technologies, and general usage patterns.

In developing this document, existing data sources have been used to present an estimated demand and supply picture of energy in Maryland. Use of publicly available data supports a cost-effective approach and provides a basis upon which to explore key energy issues facing Maryland and to help determine real-world opportunities for reliable, affordable, and clean energy for our citizens.

2.0 OVERVIEW OF ENERGY SUPPLY, DEMAND, AND PRICES IN MARYLAND

According to the latest data from U.S. DOE's Energy Information Administration (EIA), Maryland's total energy demand in 2006 was 1,452 Trillion Btu, or approximately 1.5% of all energy demand in the United States.[1] To meet that demand, energy supplies continue to be met by a substantial volume of imports in many of Maryland's energy sectors. Direct use fuels such as coal, natural gas, and petroleum are imported internationally, as well as from southern and western states that have available supplies. With almost 91% of the transportation sector dependent on petroleum resources, Maryland imports well over 400 trillion BTUs of petroleum products to meet consumer demand.[2] In the electrical sector, Maryland not only imports most of the fuels needed to generate electricity, but imports approximately 23% of its electrical energy from surrounding states.[3]

Maryland has no known petroleum production areas and is dependent on product deliveries from other areas of the country as well as from abroad. The state is supplied primarily by the Colonial Pipeline on its way from the Gulf region to major Northeast population centers. In 2005, ethanol became an additive for motor gasoline in Maryland to support clean air policies. Ethanol requires truck, rail or barge transport, which exposes Maryland to potential supply disruptions, such as that occurring after Hurricanes Katrina and Rita. To fulfill Maryland's ethanol blending needs, an annual ethanol supply of approximately 300 million gallons is imported.[4]

Demand for natural gas is strong with EIA reporting that nearly one-half of Maryland households use natural gas for home heating. Maryland utilizes interstate natural gas deliveries and imports from abroad. Major pipelines originate from the Gulf Coast to help supply natural gas to Maryland consumers. These include pipelines from five major entities: Columbia Gas Transmission Corp., Dominion Transmission Co., Eastern Shore Natural Gas Co., Texas Eastern Transmission Corp., and Transcontinental Gas Pipeline Co. One of five existing U.S. liquefied natural gas (LNG) import facilities is located at Cove Point on the Chesapeake Bay's western shore. The Marcellus Shale formations, as part of the Appalachian mountain area in western Maryland, may provide additional gas supplies into the future depending on commodity price and resources need to extract the supply from shale formations.

While Maryland has some coal resources in the western part of the state, actual mining operations are limited and little of this resource is being used to provide energy in Maryland. Most of the coal used in Maryland comes from western states. Heavily dependent on rail transportation, coal comes from as far away as the Powder River Basin in Wyoming as well as from other mines as close as West Virginia.

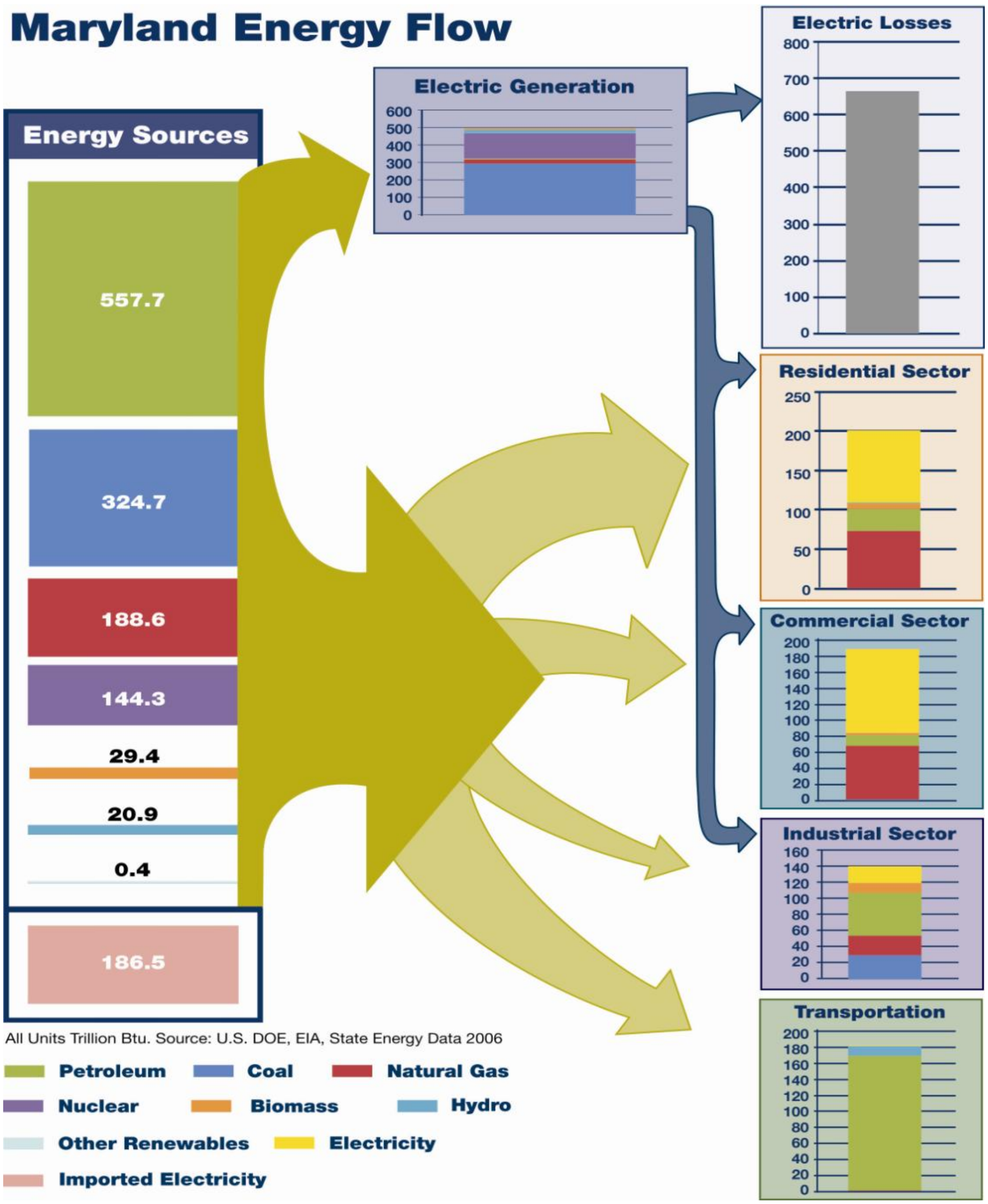
Electricity is generated both in-state at Calvert Cliffs nuclear plant, and is also imported from out-of-state generating facilities. In 2007, 15,193,000 MWh or approximately 23% of electricity was imported from out of state.[5] Of the electricity generated in 2007, 88% was derived from two sources: coal-fired and nuclear-powered generation facilities.[6]

[1] Energy Information Administration (EIA), State Energy Data 2006: Consumption, Table S1.
[2] EIA, State Energy Data 2006: Consumption, Maryland, Table 11.
[3] EIA, State Energy Data 2006: Consumption, Maryland, Tables 8-12.
[4] Based on assumption that most gasoline consumed in Maryland is blended with 10% ethanol.
[5] EIA, State Energy Data 2006: Consumption, Maryland, Tables 8-12.
[6] EIA, State Electricity Profiles 2007, Maryland, Table 5.

Maryland is part of the PJM Interconnection, or power grid, which currently encompasses 13 states and the District of Columbia. PJM has an installed capacity of 163,000 MW, serving more than 50 million people. PJM serves as the area's regional transmission organization (RTO), ensuring the reliability of the electric power supply system for all electricity consumers. PJM operates the wholesale electricity market, and manages a long-term regional electric transmission planning process to maintain the reliability of the power supply system.

Exhibit 1 presents a visual picture of Maryland's total energy supply, distribution, and use.

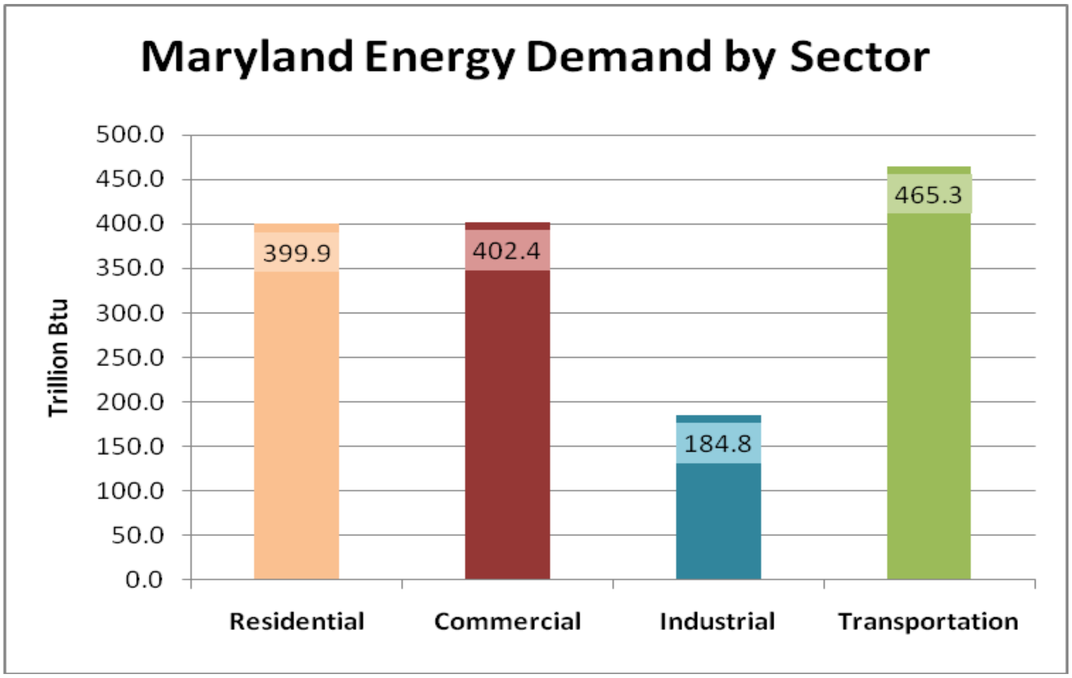
Exhibit 1



2.1 Energy Demand

As illustrated below in Exhibit 2, among the four end-use sectors, the transportation sector consumes 32% of all energy in Maryland, and residential and commercial sectors each account for 28% of total energy demand.[7] The most notable difference between national energy demand patterns and Maryland's demand is in the industrial sector. While in Maryland the industrial sector consumes only 13% of total energy, nationally, the industrial sector accounts for the largest share of total energy demand, 32%.[8]

Exhibit 2



Source: U.S. DOE, EIA, State Energy Data 2006 (latest available data)

[7] EIA, State Energy Data 2006: Consumption, Maryland, Tables 8-11.
[8] EIA, State Energy Data 2006: Consumption, Table S1.

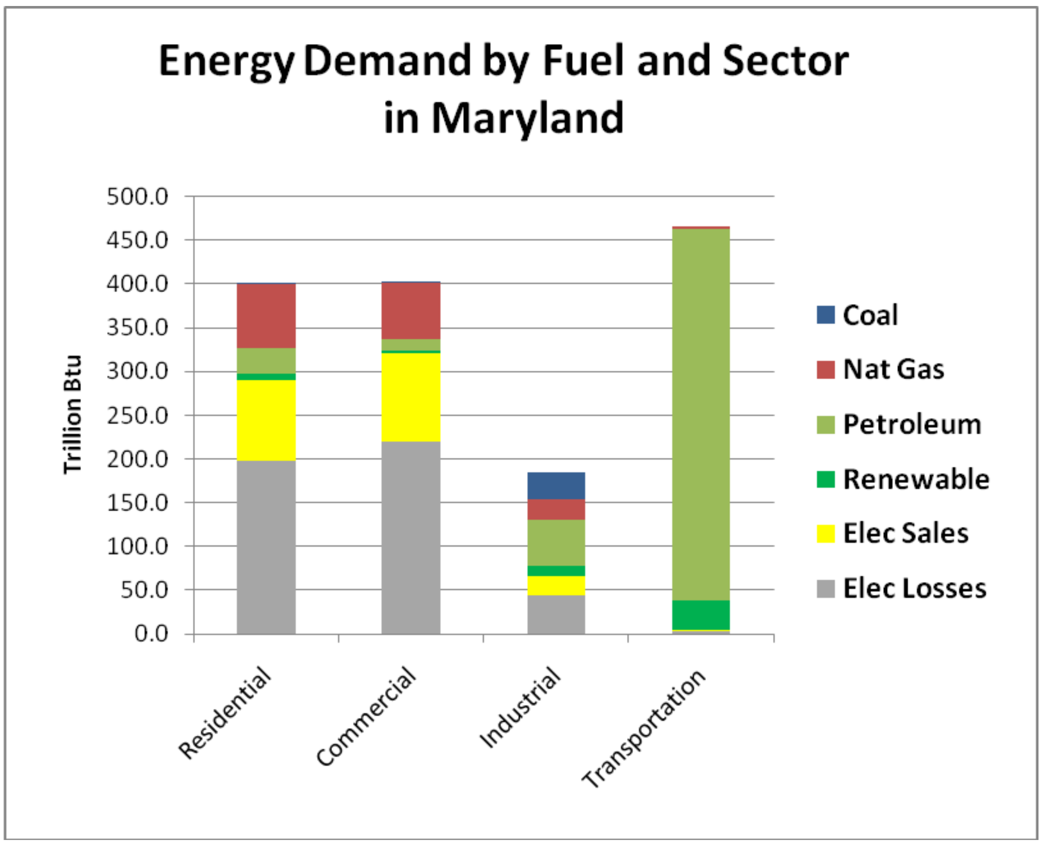
As illustrated in Exhibit 3, in the residential sector, electricity accounts for 73% of all energy demand. Natural gas, petroleum products, and wood account for 18%, 7% and 2%, respectively.[9] In addition, a small but growing portion of residential sector energy comes from distributed generation (DG) in behind-the-meter installations using solar photovoltaics and small wind turbines.

In the commercial sector, 79% of all energy demand is from electricity, while natural gas is the other major fuel source, comprising 16% of commercial sector energy demand.[10]

Compared to the residential and commercial sectors, the energy mix in the industrial sector is more diverse. 35% of all industrial energy demand is from electricity. Petroleum products are the second largest energy source at 29%, followed by coal (16%), natural gas (13%), and biomass (7%).[11]

Not surprisingly, the vast majority of energy demand in the transportation sector is from petroleum. In 2006, petroleum accounted for 91% and biofuels approximately 7% of all energy demand in the sector.[12]

Exhibit 3



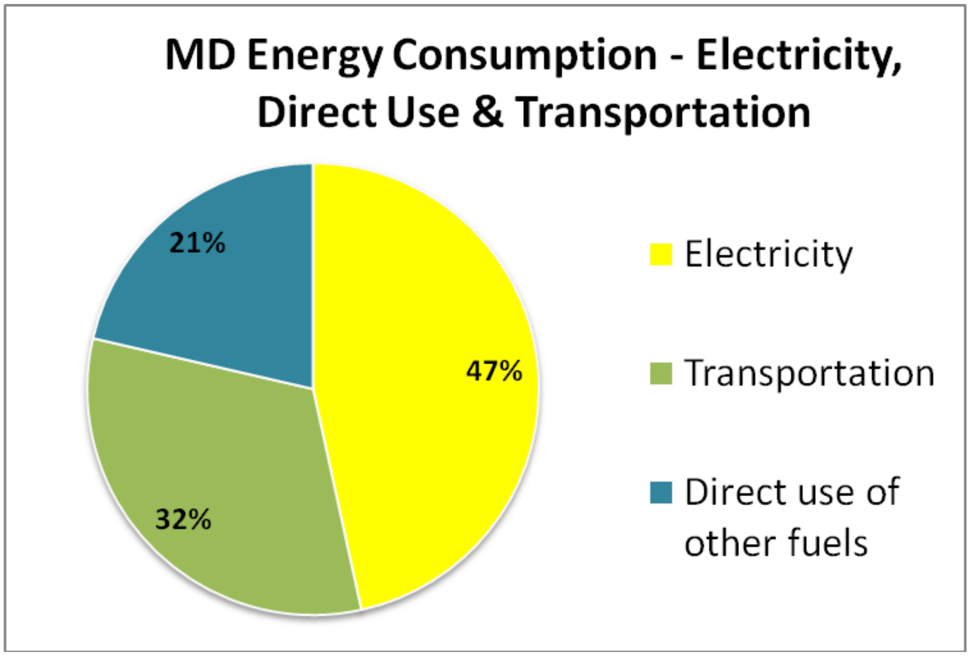
Note: Petroleum includes motor gasoline, diesel, heating oil, propane, and other petroleum products. Renewable energy includes wood and other biomass, geothermal, solar and wind energy.
Source: EIA State Energy Data 2006 (latest available data)

[9] EIA, State Energy Data 2006: Consumption, Maryland, Table 8.
[10] EIA, State Energy Data 2006: Consumption, Maryland, Table 9.
[11] EIA, State Energy Data 2006: Consumption, Maryland, Table 10.
[12] EIA, State Energy Data 2006: Consumption, Maryland, Table 11.

2.2 Direct Use Fuels, Transportation and Electricity – Overview

Maryland consumers use direct fuels to heat their homes and to drive commerical or industrial processes. They use energy for transportation, shipping bulk commodities and products, shopping, traveling and daily work activities. They use electricity in a variety of ways, from powering their homes, businesses and industry to keeping the lights on and handling everyday chores. As shown in Exhibit 4, while 47% of our energy is consumed as electricity, transportation and direct use account for the other 53%.[13] This section presents additional data on energy demand and supply for direct use, transportation, and electricity.

Exhibit 4



Source: EIA State Energy Data 2006 (latest available data)

[13] EIA, State Energy Data 2006: Consumption, Maryland, Tables 8-12.

2.3 Per Capita Use of Energy

As indicated in Table 1 below, based on the latest available data from EIA, per capita use of energy in the residential sector in Maryland is on par with other Mid-Atlantic States.

Table 1

Mid-Atlantic States & District of Columbia	Per Capita Energy Use in Residential Sector (million Btu per person)
District of Columbia	57
New Jersey	66
Maryland	71
Pennsylvania	74
Delaware	75
Virginia	77

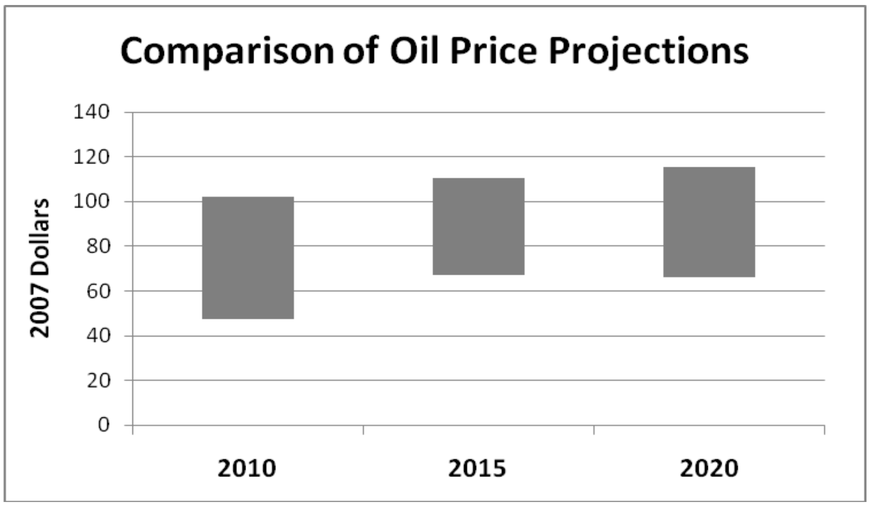
Source: EIA, State Energy Data 2006: Consumption, Maryland, Tables 8, C5.

2.4 Energy Price Outlook

2.4.1 Oil Prices

As the last few years have proven, projecting future oil prices is a very inexact science and prone to many unexpected variations. In its *Annual Energy Outlook 2009*, the EIA projects that oil prices will reach $80 per barrel in 2010, $110 in 2015, and $115 in 2020 (in 2007 dollars). Many other credible organizations and agencies have published oil price projections, and Exhibit 6 identifies the price ranges for 2010, 2015 and 2020 in seven different price forecasts. For 2015 and 2020 prices, EIA projects higher prices than most of the other projections.[14]

Exhibit 6



Source: EIA, *Annual Energy Outlook 2009, Comparison with Other Projections*

2.4.2 Natural Gas Prices

The *Annual Energy Outlook 2009* projects that on a national basis, natural gas prices will increase between 2008 and 2018, as more expensive domestic sources are used to meet demand. *AEO 2009* projects Henry Hub natural gas prices to increase 6% from 2007 to 2018, from an average of $6.96 per million British thermal unit (MMBtu) of energy in 2007 to $7.38 per MMBtu in 2018.[15] As with price projections for other fuels, economic growth rates will affect future demand and prices of natural gas. In addition, the pace of technological progress in natural gas production will affect prices.

2.4.3 Coal Prices

The *Annual Energy Outlook 2009* expects the growth in coal demand to slow compared to past decades. *AEO 2009* forecasts that U.S. average coal prices will increase in the short term, from $1.27 per MMBtu in 2007 to $1.47 per MMBtu in 2009. After this initial increase, coal prices are expected to gradually go down, reaching $1.41 per MMBtu in 2018.[16]

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[14] EIA, *Annual Energy Outlook 2009*, Comparison with Other Projections, Table 16. Organizations included in comparison: Deutsche Bank AG, IHS Global Insight, International Energy Agency, Institute of Energy Economics and the Rational Use of Energy at the University of Stuttgart, Energy Venture Analysis, Inc., and Strategic Energy and Economic Research, Inc.

[15] EIA, Annual Energy Outlook 2009, Figure 64.

[16] EIA, Annual Energy Outlook 2009, Figure 80.

2.4.4 Electricity Prices

According to the EIA, average Maryland electricity rates in 2007 were $0.1189 per kilowatt-hour (kWh) for residential customers, $0.1158 per kWh for the commercial sector, and $0.0941 per kWh for the industrial sector. [17]

As seen in Table 2, a price comparison of residential electricity rates among mid-Atlantic states for April 2008 and 2009 shows that Maryland 's rates are higher than a number of these states, as well as compared to the national average.

Table 2

Residential Electricity Prices (cents/kWh)		
State/Area	**April 2008**	**April 2009**
Delaware	13.87	14.20
New Jersey	14.05	15.89
Maryland*	***13.34***	***14.82***
Pennsylvania	11.17	11.61
Washington D.C.*	11.11	12.73
Virginia	8.97	10.73
West Virginia	7.06	7.97
National average	*11.02*	*11.59*

Source: EIA, Electric Power Monthly, July 2009, Table 5.6.A

*Denotes states/jurisdictions with restructured electricity markets

Future electricity prices in Maryland will depend on the price of fuel required by generation facilities and operation of the regional electricity marketplace. While base load coal and nuclear generation prices have served to set electricity prices for over 70 to 80% of the time, gas fired generation has set somewhat higher prices during peak demand periods.[18] Our electric pricing structure is dependent on the operation of deregulated markets and energy price bids as proposed by generation companies or third party suppliers. In addition, transmission system constraints in the Mid-Atlantic region cause electric providers to pay congestion charges for the electricity they deliver. Thus, relieving regional transmission constraints may lower electricity prices in Maryland, assuming that the levelized cost of transmission upgrades is not higher than the congestion charges.

In its 2008 *Energy Efficiency: The First Fuel for a Clean Energy Future,* the American Council for an Energy Efficient Economy (ACEEE) estimates that aggressive energy efficiency policies recommended in the report would reduce wholesale electricity prices in Maryland by $0.002 by 2015 and $0.011 in 2025 compared to ACEEE's reference case.[19]

[17] EIA, *State Electricity Profiles 2007, Maryland,* Table 8.
[18] Monitoring Analytics, LLC, *2008 State of the Market Report for PJM.*
[19] ACEEE, Energy Efficiency: The First Fuel for a Clean Energy Future, page 23.

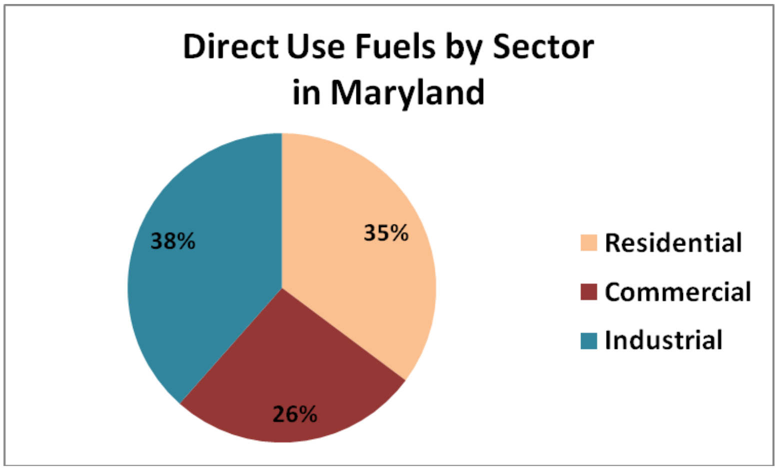
3.0 DIRECT USE FUELS

Direct use fuels accounts for 21% of total Maryland energy demand. [20] The fuels included are natural gas, coal, petroleum and biomass.

3.1 Current Situation

When analyzed by end use sector, as seen in Exhibit 7, the industrial sector accounts for the greatest share of direct use fuels, followed by residential and commercial sectors.

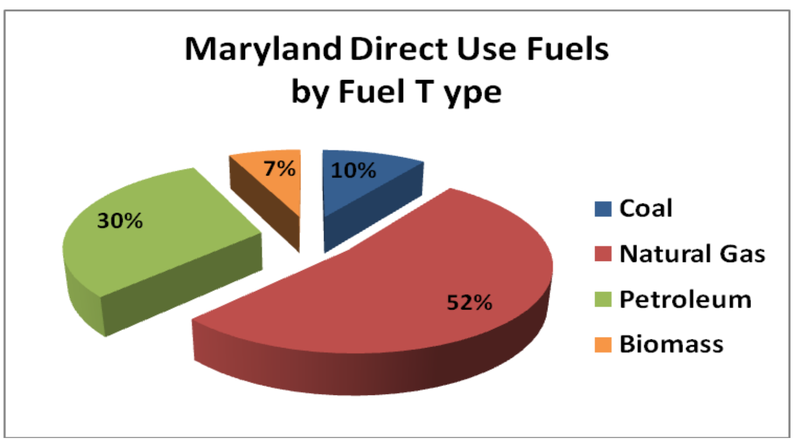
Exhibit 7



Source: EIA State Energy Data 2006: Consumption, Tables 8-10 (latest available data)

When broken down by fuel type, as illustrated in Exhibit 8, natural gas accounts for 52% of direct use fuels. Petroleum products, which include heating oil, propane and other petroleum-based products, account for 30% of direct use fuels. Coal demand is 10% and biomass 7%.[21]

Exhibit 8

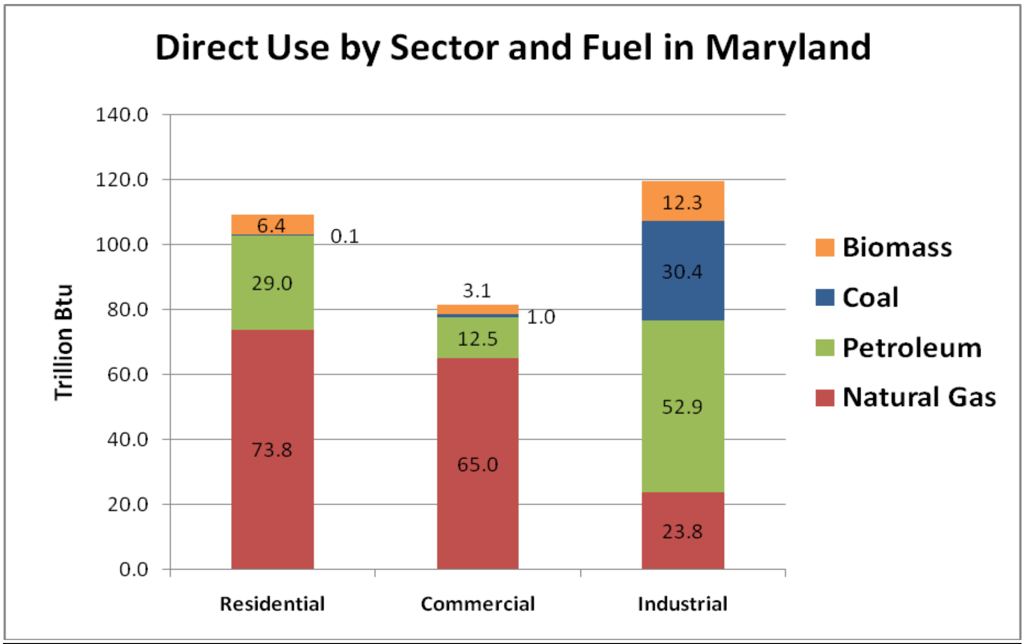


Source: EIA State Energy Data 2006 (latest available data)

[20] EIA, State Energy Data 2006: Consumption, Tables 8-10.
[21] EIA, State Energy Data 2006: Consumption, Tables 8-10.

Exhibit 9 further breaks down direct use of fuels in the residential, commercial and industrial sectors. In both residential and commercial sectors, direct use of fuels is dominated by natural gas. The direct use fuel mix in the industrial sector differs markedly from the residential and commercial sectors. In the industrial sector, petroleum-based products dominate.

Exhibit 9



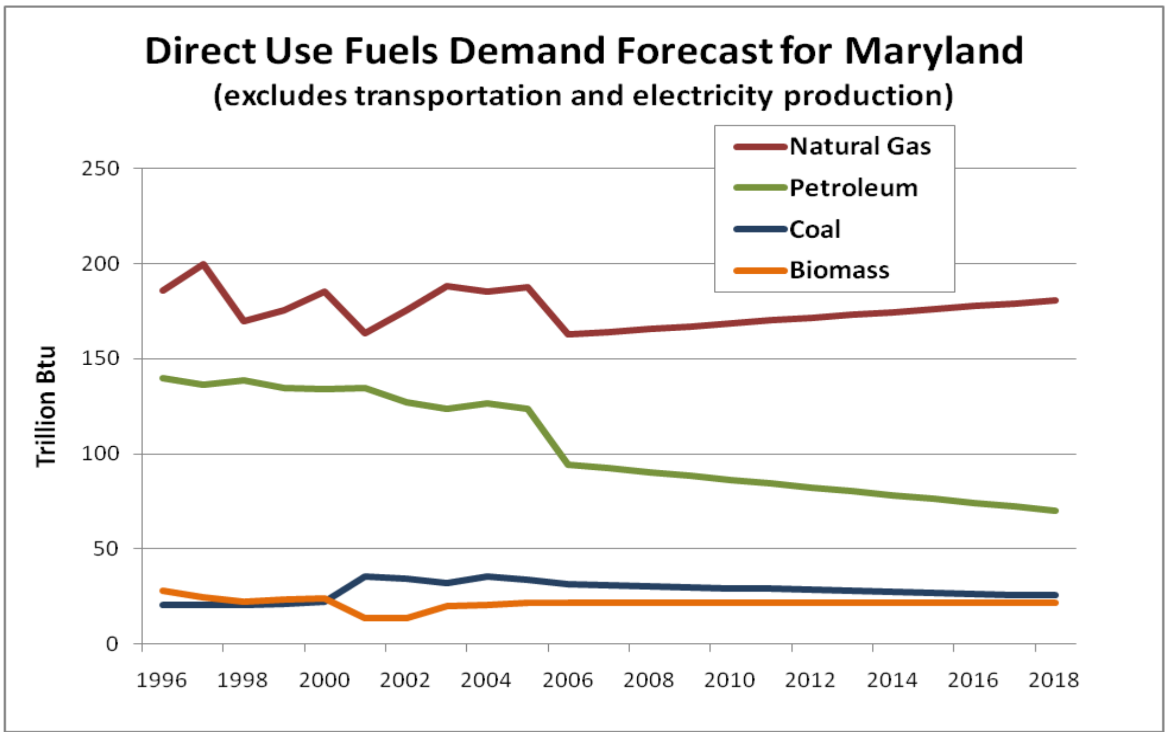
Note: Biomass includes wood and other biomass waste. Petroleum includes motor gasoline, diesel, heating oil, propane, and other petroleum products.
Source: EIA State Energy Data 2006: Consumption, Tables 8-10 (latest available data)

3.2 Future Outlook for Direct Use Fuels

There are no Maryland-specific demand projections for direct use of natural gas, petroleum, coal or biomass. In the absence of such data, future demand projections for direct use of these fuels has been developed by extrapolating from EIA historical demand data from 1995 to 2006, assuming that past trends will likely continue over the next ten years. As seen in the exhibit below, direct use of natural gas is expected to increase between 2006 and 2018 by 11%. In contrast, direct use of petroleum is expected to decrease by 17% between 2006 and 2018. Based on past demand patterns, direct use of coal and biomass is expected to remain relatively constant.

These demand projections can be affected by future price developments for the fuels in question. For example, high oil prices combined with relatively low natural gas prices could further increase natural gas demand and depress petroleum demand. If fossil fuel prices escalate rapidly, demand for biomass can be expected to go up. Biomass demand levels are likely to be sensitive to possible future carbon costs and other policy incentives that may be enacted by federal or state governments.

Exhibit 10



Source: EIA State Energy Data 2006: Consumption, Tables 8-10 (latest available data); future projection extrapolated from historical data by Princeton Energy Resources International

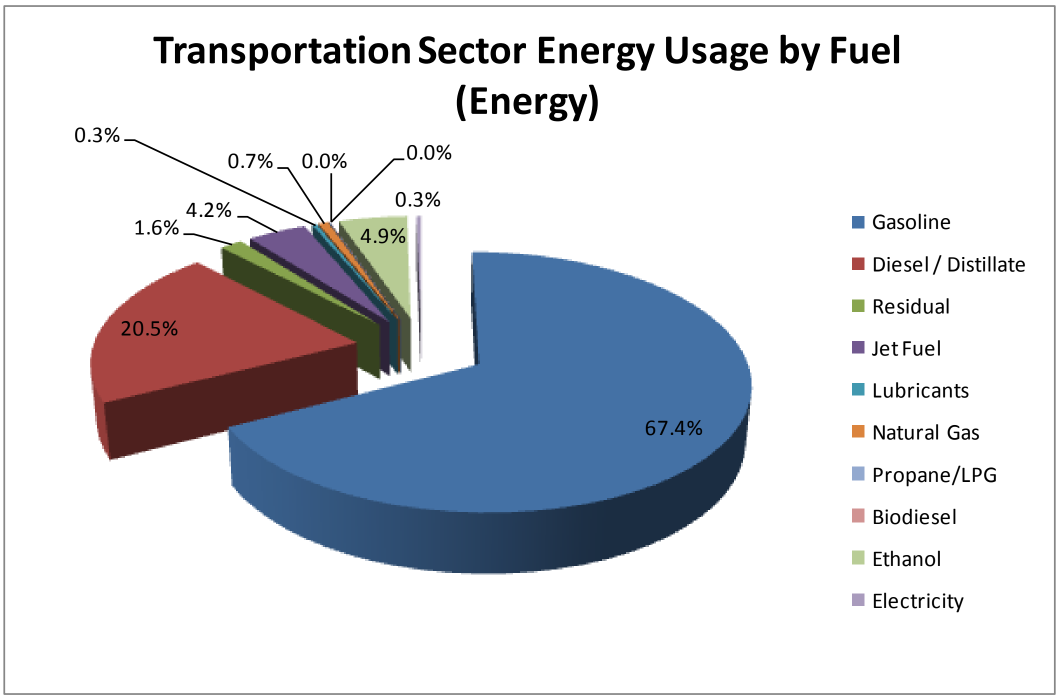
While the above chart reflects a best estimate of future direct fuel demand, based on past demand data, there are additional considerations which might impact Maryland direct use fuel demand. As an example, the potential for fuel switching from the electric sector to direct use natural gas may increase the demand for natural gas while reducing electric generation needs. In certain instances, switching from electricity to direct fuel sources may also improve the efficiency of the energy use process and lessen demand on other fuels.

4.0 Transportation

4.1 Current Transportation Energy Baseline

Total baseline Maryland transportation fuel use is approximately 4.1 billion gallons, or 476 trillion Btu of energy. The baseline fuel use values in Exhibits 11 and 12 show that gasoline and diesel account for 86.6% of fuel demand by volume and 88.2% of fuel demand on an energy basis. Ethanol is the next largest fuel, primarily due to its usage in E10 gasoline blends (7.5% by volume, 4.9% by energy). All of the other fuels play a minor role in the State's transportation energy market. Natural gas use includes the fuel used in powering petroleum and natural gas pipelines, which EIA includes in the transportation sector data. This is the major end-use for natural gas fuel in the transportation sector. On-road transportation accounts for the largest percentage of fuel use (90.5% by volume, 89.5% by energy). The marine sector is the second largest (roughly 4.5%) followed closely by the aircraft sector (roughly 3.75%).[22]

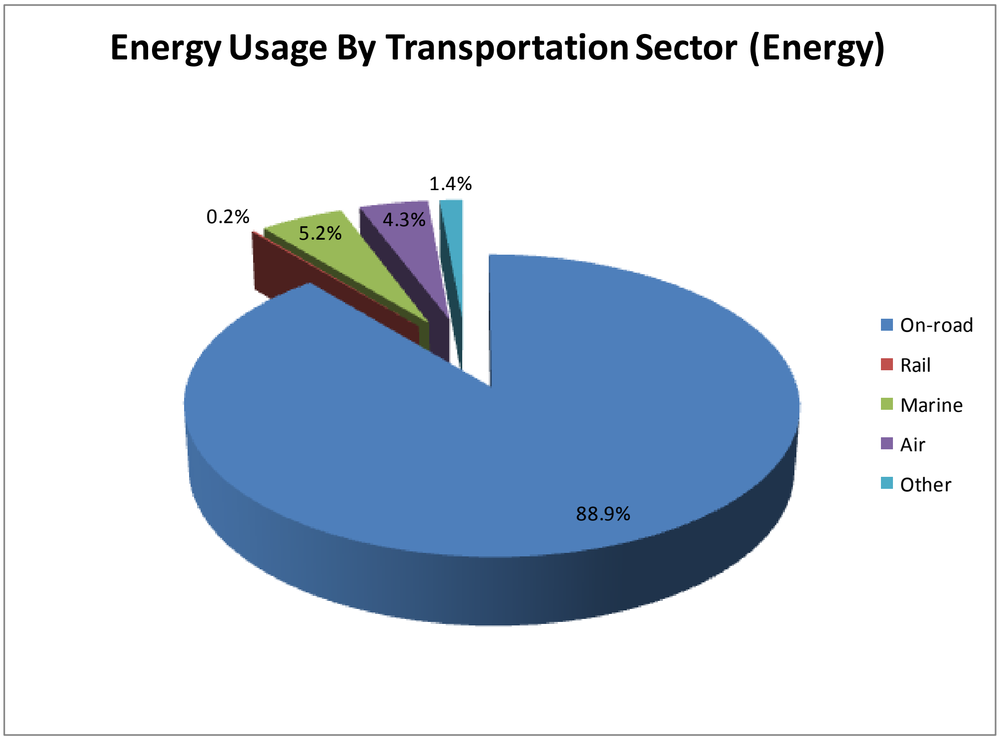
Exhibit 11



Source: EIA State Energy Profile, FHWA Highway Statistics, Maryland Department of the Environment, Maryland Clean Cities Coalition

[22] Maryland State Energy Profile Website, U.S. Department of Energy, Energy Information Administration, http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=MD; Highway Statistics, U.S. Department of Transportation, Federal Highway Administration, http://www.fhwa.dot.gov/policy/ohpi/hss/index.cfm; Maryland Clean Cities Coalition, Historical Biofuels Usage Data.

Exhibit 12



Source: EIA State Energy Profile, FHWA Highway Statistics, Maryland Department of the Environment, Maryland Clean Cities Coalition

4.2 Future Outlook

A thorough review of existing sources has been done to locate historical and projected fuel demand and supply as well as other relevant data such as population and economic growth.[23]

In some cases, future transportation fuels have not been included in the MDCAP (e.g., biodiesel and ethanol). In these cases, historical biofuel (biodiesel blends and E85 [a blend of 85% ethanol and 15% gasoline by volume]) sales volume data developed for MEA for the Maryland Clean Cities Coalition outside of this project have been used as the basis of the projections with conservative assumptions for annual growth in the future. According to MDE most of the gasoline in Maryland contains 10% ethanol (i.e., E10), so 10% of the gasoline fuel volume is assumed to be ethanol.[24] In other cases, fuels have been presented in a combined category (e.g. natural gas, liquefied petroleum gas [propane], and lubricants). In these cases the most accurate data from other sources such as the EIA State Energy Data or from the USDOT have been used.

4.2.1 Fuel Supply Outlook

As mentioned earlier in this document, no existing transportation fuel supply forecasts have been identified within the literature. As a nearly one-hundred percent energy import state, Maryland must rely on outside supplies to meet transportation fuel demands. Relatively small projected annual Maryland transportation demand side increases are expected to be met by supply side market improvements. For example, the current ethanol fuel supply is sufficient for meeting the projected demand through 2014. After that, the modest projected annual increases do not represent a large enough change in market conditions to warrant a future supply issue. This rationale does not hold true for future biodiesel demand. Biodiesel use in the low-petroleum/high-biofuels case, which allows the State to meet the EISA RFS requirements, represents a significant shift from current biodiesel use. By 2018 the biodiesel portion of the Maryland diesel fuel pool will reach roughly 4% of the diesel fuel volume.[25] This is a notable shift that will require significant and immediate additional biodiesel fuel supply, and blending infrastructure to be developed. However, this approach does not require developing additional distribution and fueling infrastructure, as would be necessary in higher level blends, since it would be used in the entire diesel fuel pool.

[23] Data sources include: Maryland Energy Administration (MEA), Maryland Department of the Environment (MDE), Maryland Department of Transportation, U.S. Census Bureau, U.S. Department of Defense, U.S. Department of Transportation (USDOT), U.S. Department of Energy (USDOE) - Energy Information Administration (EIA), Regional Greenhouse Gas Initiative, American Council on an Energy Efficient America, and the Chesapeake Bay Foundation. The Maryland Climate Action Plan (MDCAP) transportation data was used as the basis for this task work. The MDCAP study used data from the 2005 EIA State Energy Profile data, so the baseline values were updated using the most current EIA State Energy Profile data. Historical Maryland fleet-wide Vehicle Miles Traveled (VMT) data were obtained directly from MDE and were distributed by vehicle class using USDOT data. Projections were made using Maryland–specific trends and projections based on detailed research and interviews with relevant parties.

[24] Alternative Fuels and Alternative Fuel Stations webpage, Maryland Department of the Environment, http://www.mde.maryland.gov/Programs/AirPrograms/Mobile_Sources/afv/fuels.asp.

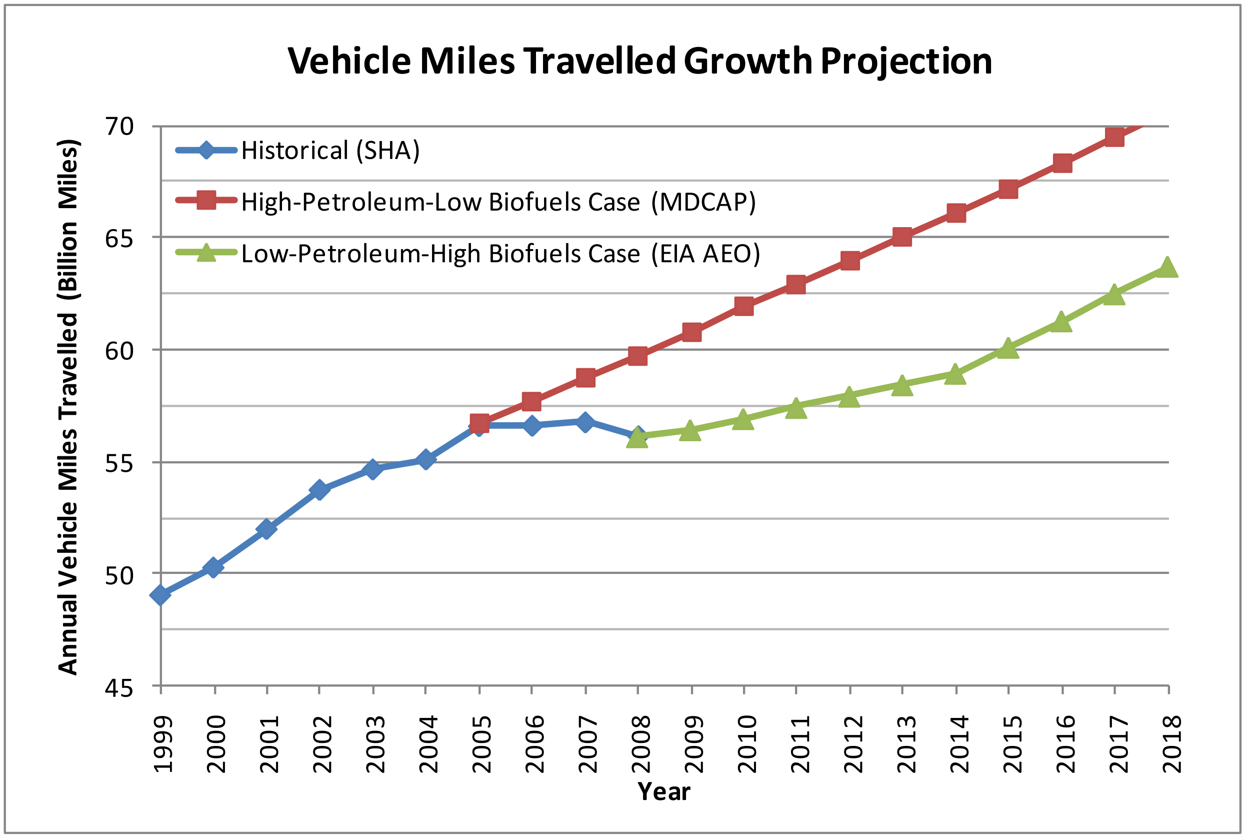
[25] Annual Energy Outlook 2009 with Projections to 2030, Supporting Data for Figure 75, Energy Information Administration, U.S. Department of Energy, DOE/EIA-0383(2009), March 2009.

4.2.2 Vehicle Miles Traveled (VMT) Projection

Historical vehicle miles traveled (VMT) data has been obtained from the Maryland State Highway Administration (MSHA).[26] VMT projections for the High-Petroleum/Low-Biofuels case have been determined by the Maryland Department of the Environment (MDE).[27] VMT projections for the Low-Petroleum/High-Biofuels case have been determined by applying national VMT growth rates from EIA to the baseline (2009) Maryland VMT value. Exhibit 13 illustrates the VMT projections.

The exhibits diverge in 2005 due to the dates when the data was obtained. The High-Petroleum/Low-Biofuels case was developed using historical data through 2005. The Low-Petroleum/High-Biofuels case was developed using historical data through 2008, which takes into account the combined impacts of higher fuel prices and the current economic downturn that occurred after the High-Petroleum/Low-Biofuels case was developed.

Exhibit 13



Source: Maryland State Highway Administration, Maryland Departmetn of the Environment, EIA Annual Energy Outlook 2009

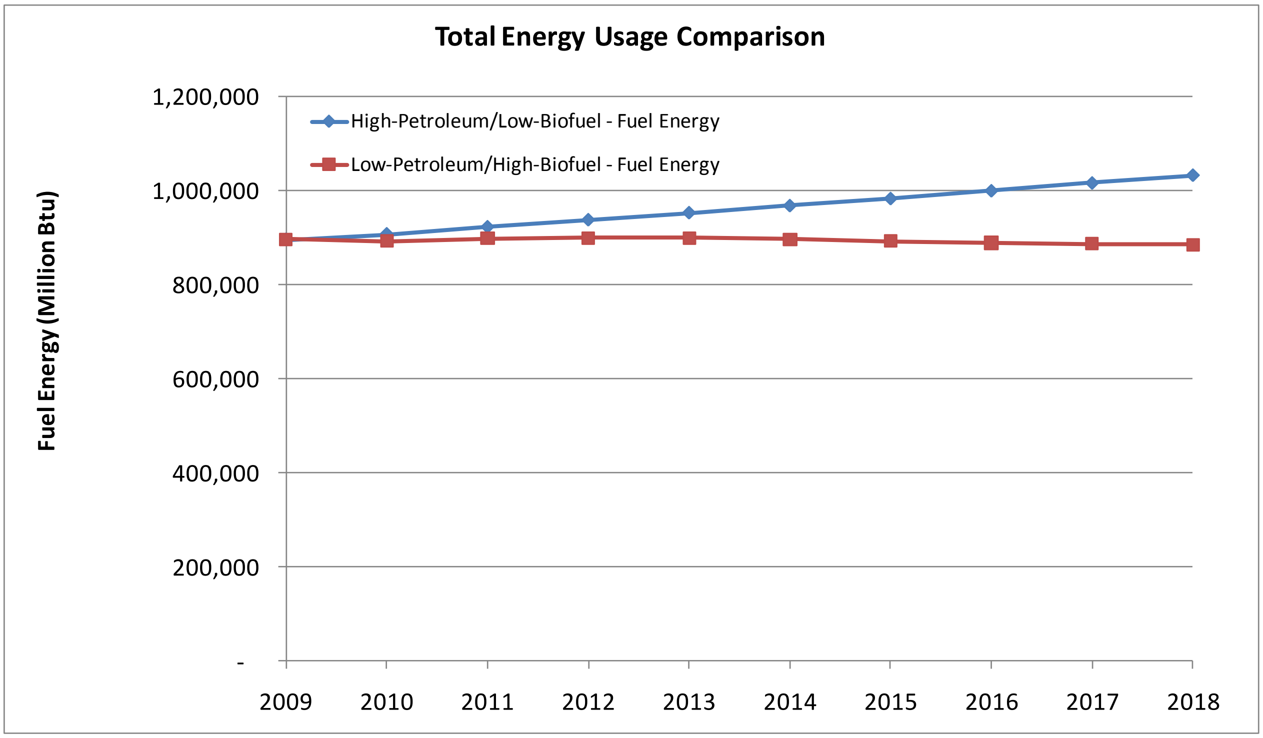
[26] *Vehicle Miles of Travel*, Maryland State Highway Administration Internet, Office of Planning and Preliminary Engineering, Highway Information Services Division, http://www.sha.maryland.gov/SHAServices/trafficReports/Vehicle_Miles_of_Travel.pdf, accessed on 07/10/2009.

[27] Projections for vehicle miles travelled for Maryland were provided by Mohamed Khan, Maryland Department of the Environment.

4.2.3 Total Fuel Demand

The combined overall fuel demand projections are shown in Exhibit 14. The High-Petroleum/Low-Biofuels case shows a steady increase in gasoline demand; this is "business-as-usual." The difference between this case and the Low-Petroleum/High-Biofuels case is a significant fuel demand decrease (14 percent in 2018) due to higher renewable fuels usage (due to Renewable Fuels Standard [RFS] requirements included in the Energy Independence and Security Act of 2007), higher fuel economy vehicles (due to increases in the Corporate Average Fuel Economy [CAFE] requirements[28]), and consumer behavior changes. Gasoline vehicle use drives the projections, since gasoline vehicles account for roughly 68% of transportation fuel. Diesel fuel vehicles account for an additional 19%. Therefore, these two classes account for roughly 87% of fuel use, so demand projection on these fuels has the largest impact.

Exhibit 14

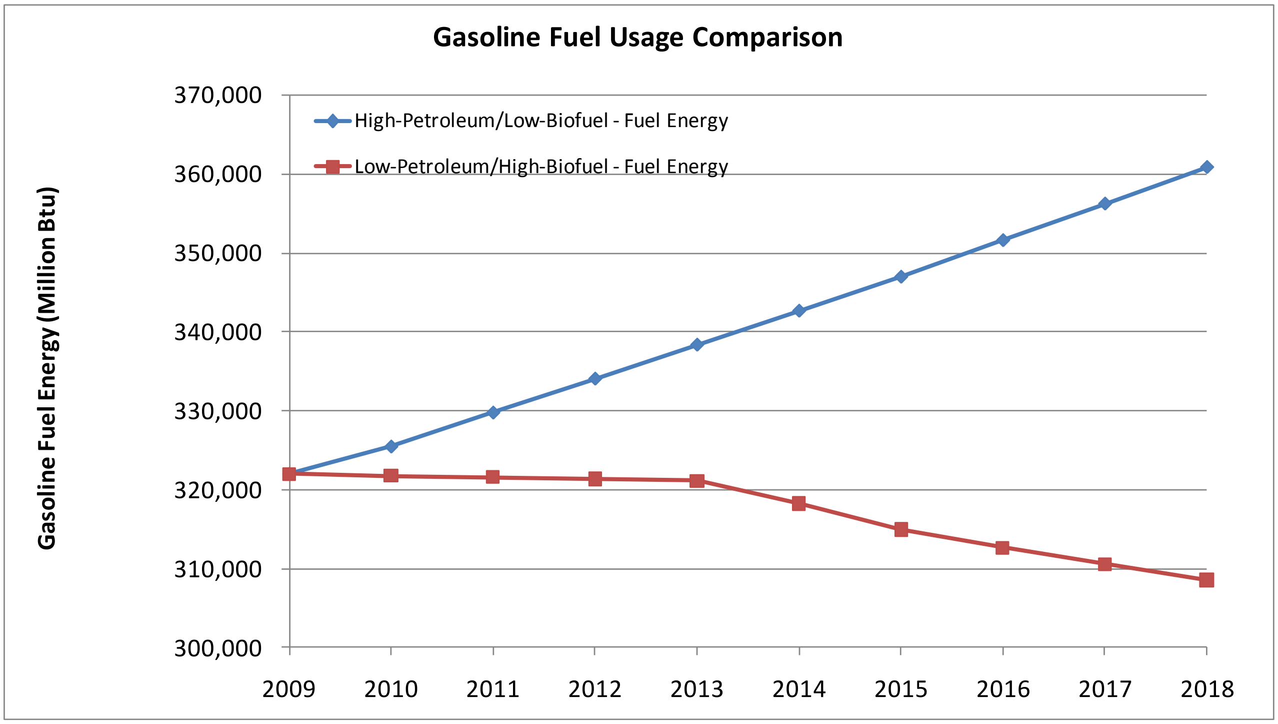


[28] Corporate Average Fuel Economy Website, National Highway Traffic Safety Administration, U.S. Department of Transportation, http://www.nhtsa.dot.gov/portal/site/nhtsa/menuitem.43ac99aefa80569eea57529cdba046a0/.

4.2.3.1 Gasoline Demand

Gasoline fuel demand projections are shown in Exhibit 15. The High-Petroleum/Low-Biofuels case - "business-as-usual" - shows a steady increase in gasoline demand, as compared to the Low-Petroleum/High-Biofuels case, which illustrates a significant gasoline fuel demand decrease (14% in 2018). Reductions are due to higher renewable fuels usage (RFS), vehicles with higher fuel economy (CAFE), consumer behavior that values vehicle purchases that are energy efficient and reflect the impacts of higher fuel prices and increased environmental sensitivity.

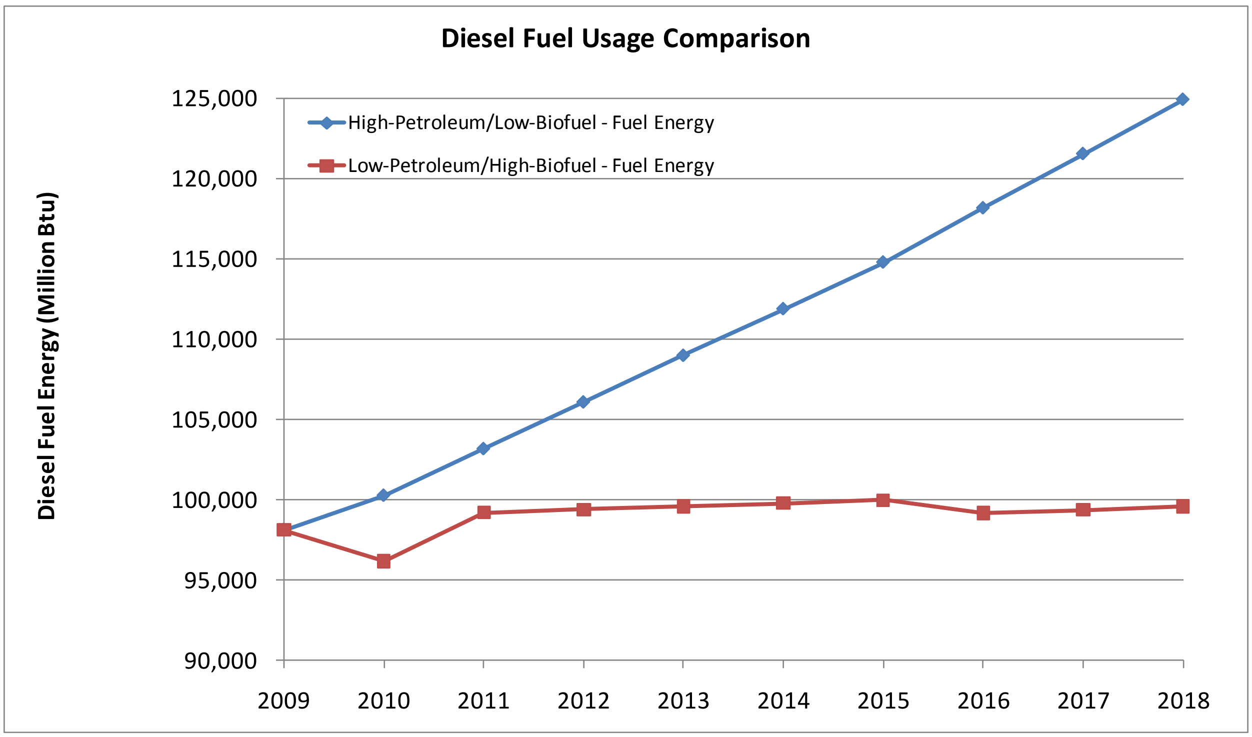
Exhibit 15



4.2.3.2 Diesel Demand

Diesel fuel demand projections are shown in Exhibit 16. The High-Petroleum/Low-Biofuels case shows a steady increase in diesel demand. The difference between the "business-as-usual" High-Petroleum/Low-Biofuels case and the Low-Petroleum/High-Biofuels results in a significant fuel demand decrease (20% in 2018) because of factors including higher renewable fuels usage (RFS). Vehicle fuel economy is not expected to significantly increase because options such as vehicle or engine displacement downsizing and hybrid powertrain systems are either not expected to be an option or are not expected to be widely used in typical diesel vehicle types.

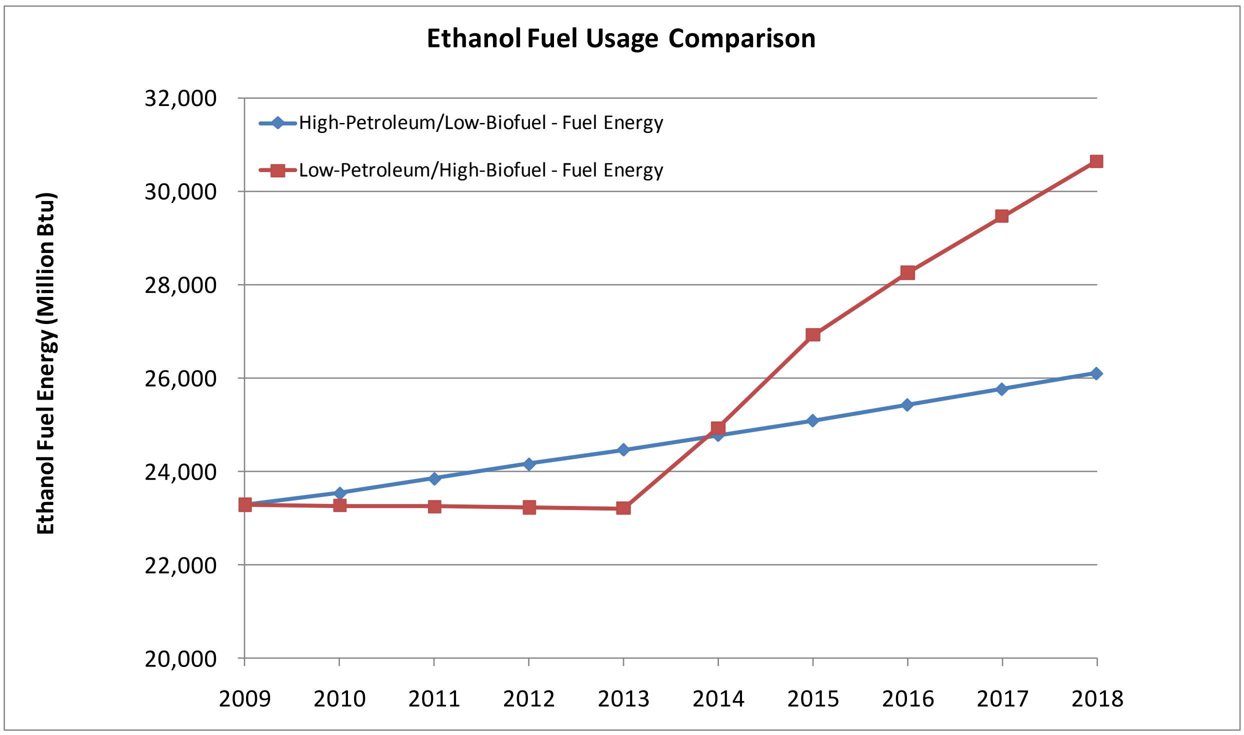
Exhibit 16



4.2.3.3 Ethanol Demand

Exhibit 17 shows the differences in ethanol fuel use projections and the impact of the EISA Renewable Fuel Standard. The E10 blend currently used in most gasoline in Maryland exceeds the EISA requirements on a percentage basis until 2014. Through 2014 the percentage of ethanol in the gasoline fuel pool is 10% by volume (7.2% on an energy basis). In order to meet the RFS after 2014 for ethanol, additional ethanol must be used. In later years in the High-Petroleum/Low-Biofuels case the percentage of ethanol remains at this percentage since ethanol use is primarily assumed to come from ethanol in E10 gasoline. In the Low-Petroleum/High-Biofuels case the percentage increases to 13.26% in 2018 to keep pace with the EISA mandates.

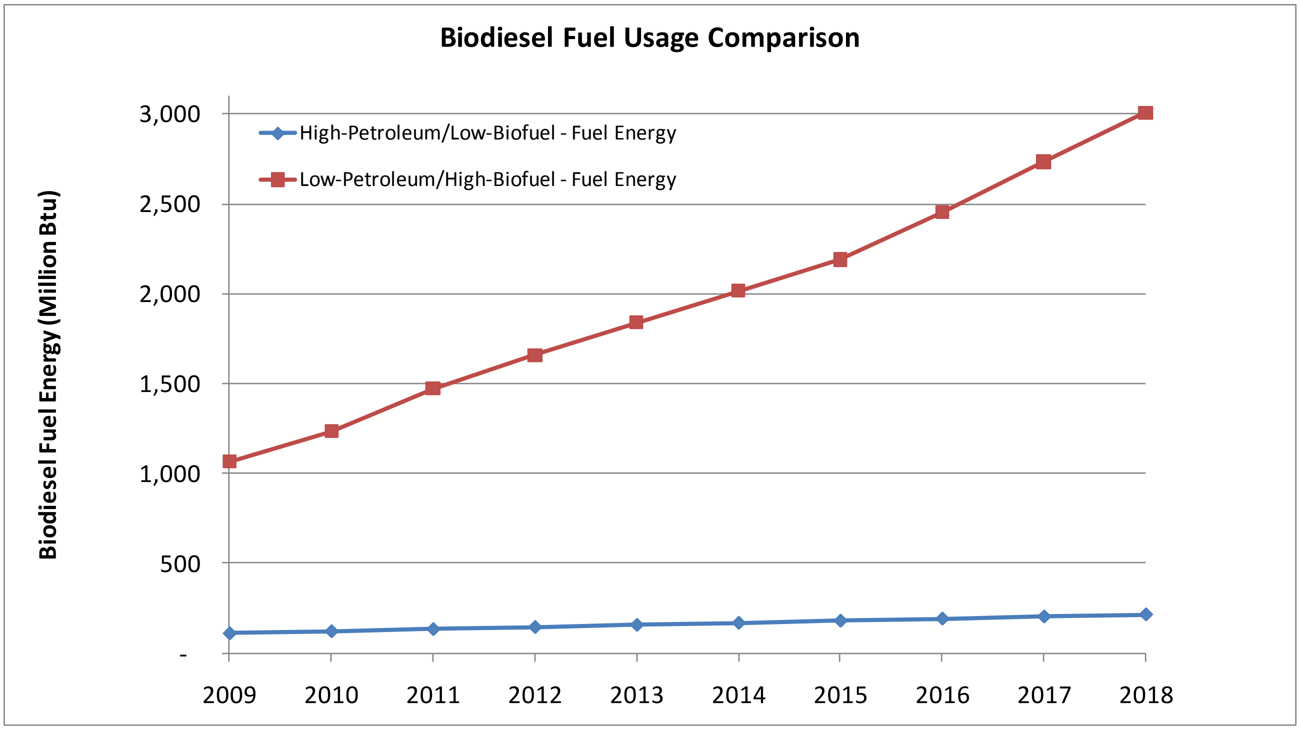
Exhibit 17



4.2.3.4 Biodiesel Demand

Exhibit 18 shows the differences in the biodiesel fuel use projections and the impact of the EISA Renewable Fuel Standard (RFS). Biodiesel use in Maryland has been increasing, but not at a rate that will allow the State to meet the RFS requirements. In fact, in the baseline year (2009) the RFS requirement is an estimated 9.8 times (8.1M gallons) higher than current use.

Exhibit 18



4.2.3.5 Future Fuel Supplies

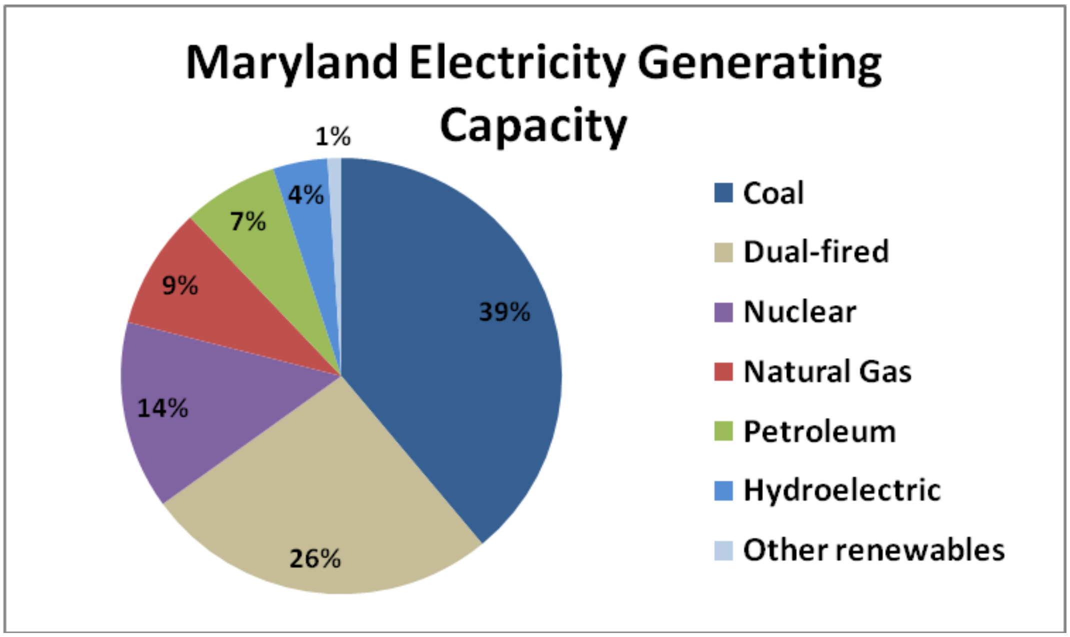
Demand and supply data for all the transportation fuels presents a clear picture of the need for some action. While the forecast assumes that market supplies of petroleum will be available to meet demand, history teaches a valuable lesson. Supply shortages in this energy intensive industry can have disastrous economic effects that reverberate throughout the economy. In the transportation sector there are potential physical supply shortages, supply disruptions, refinery capacity disruptions, transport difficulties and other factors that can lead to severe energy issues. The two most critical questions that must be answered are the extent to which new technologies for increasing fuel standards can help reduce petroleum demand and secondly, how we become more self-sustainable by increasing the use of ethanol and biofuels in our transportation sector.

5.0 ELECTRICITY

5.1 Current Maryland Electricity Generating Profile

As seen in Exhibit 19, the largest percentage of electric generation capacity in Maryland is provided by coal-fired plants. These power plants contribute approximately 39% (4,966 MW) to in-state summer peak capacity, which is energy that is required on the day of highest use, at the "peak." Dual-fired plants which can run on either gas or petroleum contribute roughly 26% (3,272 MW), nuclear power represents 14% (1,735 MW), gas (9% or 1,125 MW), petroleum (7% or 879 MW), hydroelectric (4% or 567 MW), and other renewables which include landfill gas and biomass (1% or 132 MW).[29]

Exhibit 19

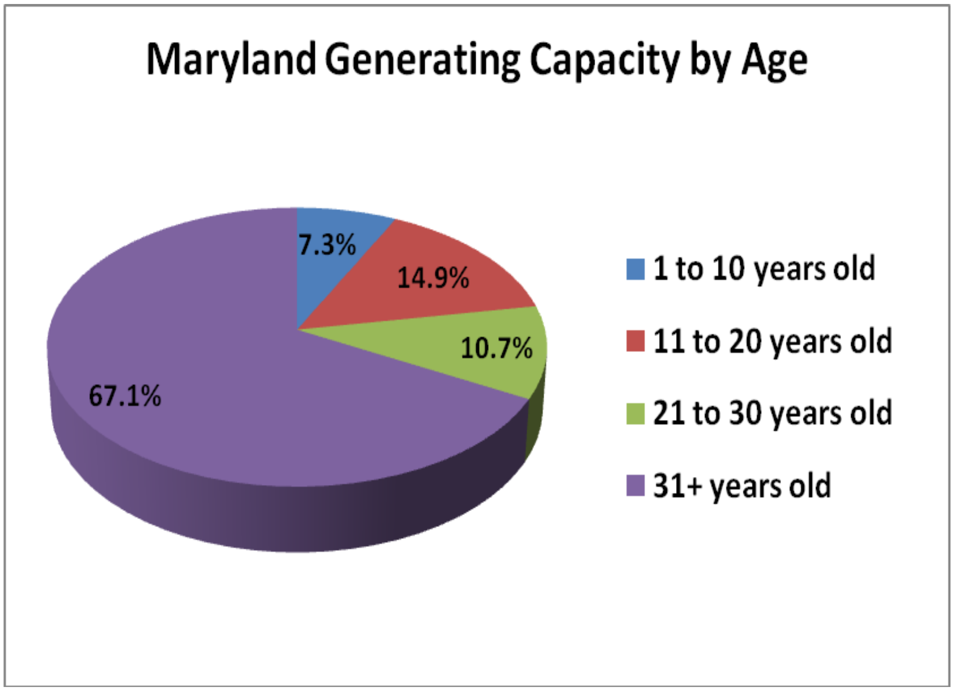


Source: Maryland Public Service Commission: *Ten Year Plan of Electric Companies in Maryland*; data as of January 1, 2009

[29] Maryland PSC, *Ten-Year Plan (2008-2017) of Electric Companies in Maryland*, Table III.B.1.

As noted in Exhibit 20, the overhwhelming majority (67%) of eletricty generating infrastrucutre in Maryland is at least 30 years old.[30] Table 3 lists the age of the state's largest generating units

Exhibit 20



Source: Maryland Public Service Commission, *Ten Year Plan of Electric Companies in Maryland*

Table 3

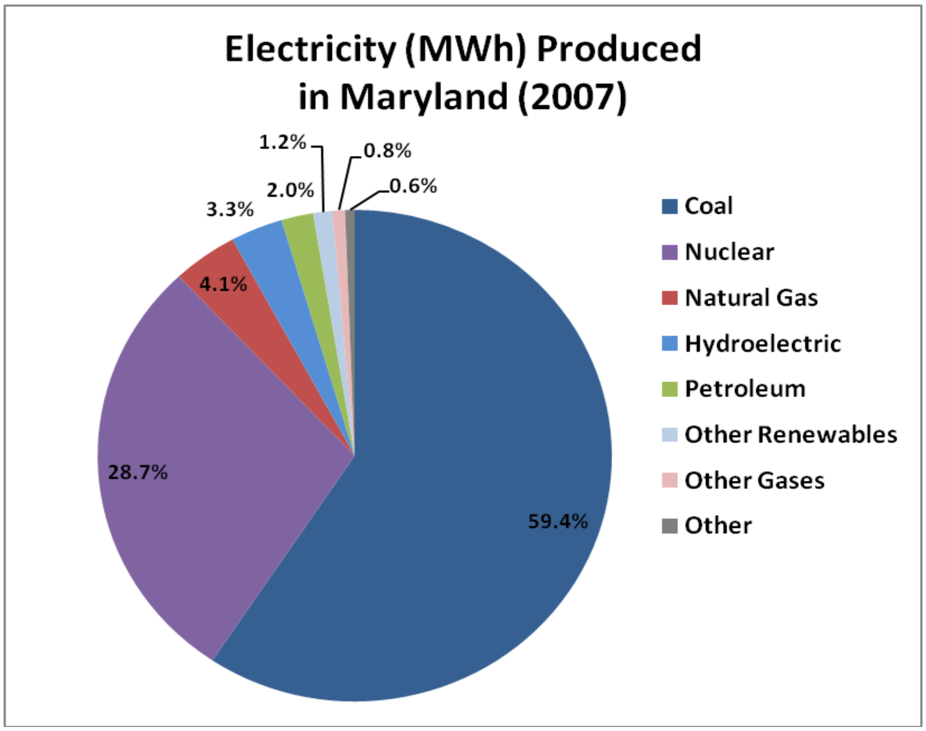
Age of Maryland's Five Largest Electricity Generating Units	
Generating Unit	**Year Units Put in Service**
Chalk Point Generating Station	1964, 1965, 1975, 1981
Calvert Cliffs Nuclear Power Plant	1975, 1977
Morgantown Generating Station	1970, 1971, 1973
Brandon Shores Generating Station	1984, 1991
Herbert A. Wagner Generating Station	1956, 1959, 1966, 1972

Source: EIA, Annual Electric Generator Report

[30] Princeton Economic Research Institute (PERI), Table 2.1 Maryland Utility Coal-Fired Units Boiler Characteristics, *Potential for Biomass Co-firing in Maryland,* DNR 12-2242006-107, March 2006.

The exhibit below illustrates the electricity (MWh) that is produced by Maryland's existing power plants. Nearly 60% (29,664,000 MWh) of all electricity generated in the State in the year 2007 was from coal.[31] Nuclear plants generated nearly 29% (14,353,000 MWh) of energy, natural gas apporoximately 4% (2,033,000 MWh), hydroelectric (3.3% or (1,660,000 MWh), petroleum (2% or 979,000 MWh), renewables (1.2% or (615,000 MWh), other gases (0.8% or 377,000 MWh) and other sources (0.6% or 287,000 MWh).[32]

Exhibit 21



Source: Maryland Public Service Commission; *Ten Year Plan of Electric Companies in Maryland* data for 2007 (latest available)

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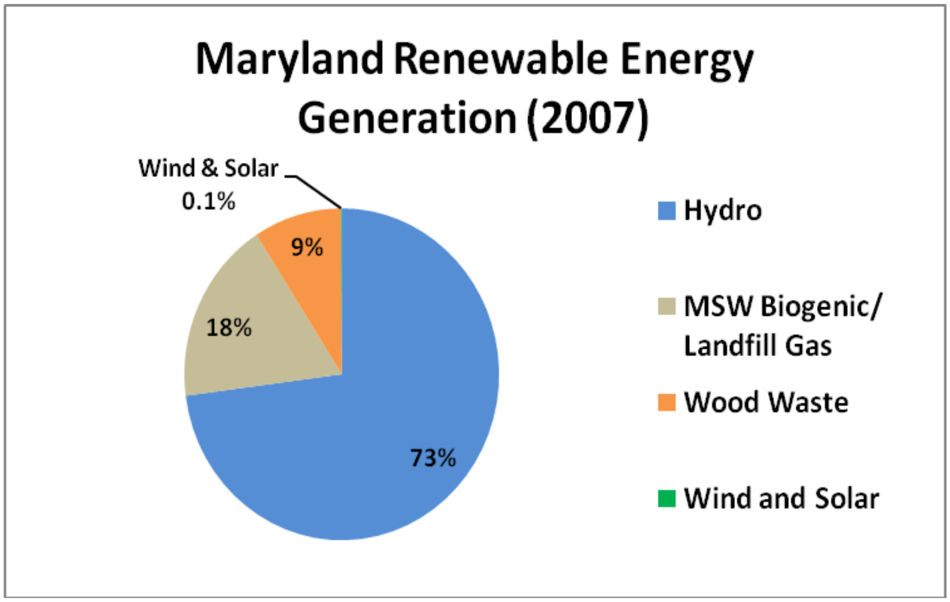
[32] Maryland PSC, *Ten-Year Plan (2008-2017) of Electric Companies in Maryland*, Table III.B.2.

5.2 Renewable Energy Generation in Maryland

Total energy generated from renewable sources in Maryland was 2,256,000 MWh in 2007. As seen in Exhibit 22, conventional hydroelectric power accounted for 73% (1,652,000 MWh) of this generation. Wood waste cogeneration of electricity represented about 9% (203,000 MWh) and Municipal Solid Waste (MSW) Biogenic[33] and Landfill Gas represented roughly 18% (400,000 MWh) of total renewable generation.[34] Wind produced roughly 210 MWh per year and solar power approximately 3,300 MWh per year in Maryland.[35] Together, these two energy sources represent approximately 0.1% of all renewable energy generation.

Exhibit 22



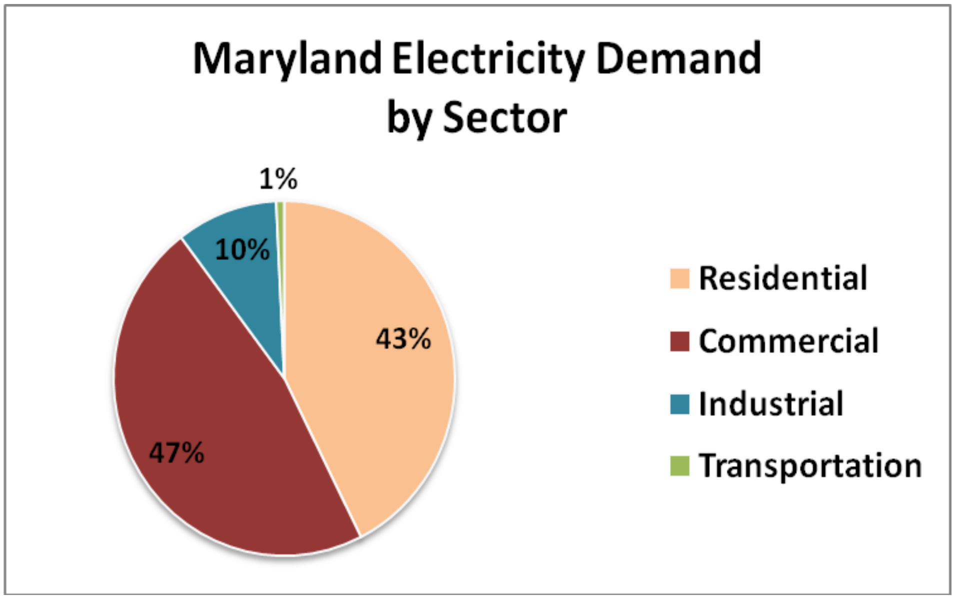
Source: EIA State Electricity Profiles, Maryland Energy Administration

[33] A biogenic substance is a substance produced by life processes.
[34] EIA, *Maryland State Energy Profile,* Table 1, June 2009.
[35] PERI, estimate of 30% capacity factor. Based on long-term data from similar projects located in Wet Virginia.

5.3 Electricity Demand

Ninety percent of all of Maryland's electrical energy is consumed in the commercial and residential sectors. The industrial sector is responsible for 10% of Maryland's electricity demand, and the transportation sector accounts for approximately 1%.[36]

Exhibit 23



Source: EIA State Energy Data 2006 (latest available data)

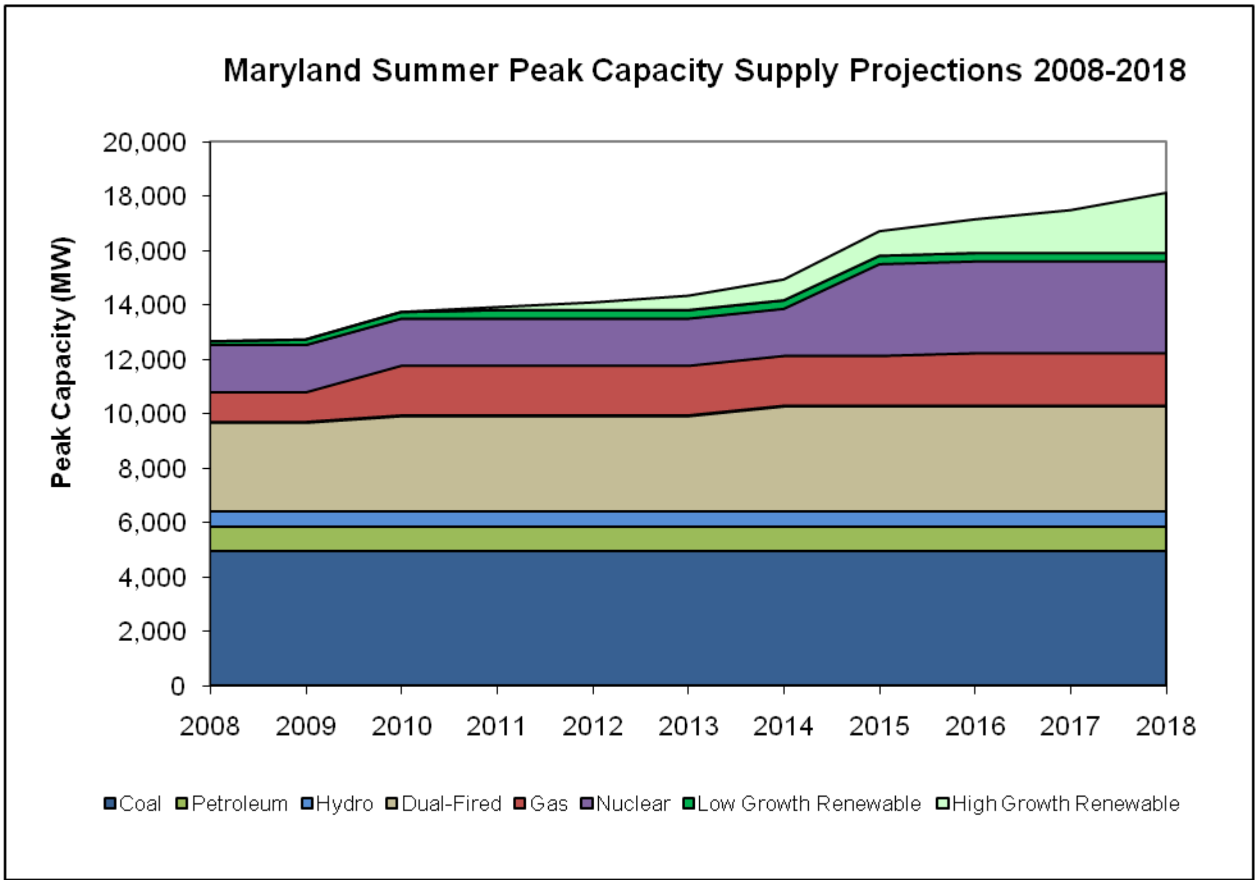
[36] EIA, State Energy Data 2006: Consumption, Maryland, Tables 8-11.

5.4 Future Outlook for Electricity

5.4.1 Electricity Capacity Projection

As forecast by the Maryland PSC in 2008 and portrayed in Exhibit 24, total electric capacity for Maryland is forecasted to increase to almost 16,000 MWs by 2018.[37] A significant portion of this increase can be attributed to the **assumption** of a gas facility at Perryman by 2010 and additional capacity at Calvert Cliffs Nuclear Power Plant by 2015. Although neither of these is likely to occur in the time frame that has been forecast, if these or other plants were actually built in Maryland in a timely fashion, they would help to offset a significant portion of Maryland's energy imports and perhaps help reduce energy prices. In addition, the exhibit includes two "wedges" – low and high growth scenarios – for renewable energy. If the high growth renewable energy scenario were achieved and the other capacity additions materialize, Maryland's total electric capacity could top 18,000 MW in 2018.

Exhibit 24



Note: Projection assumes new gas and dual-fired generation units between 2009-2015 as currently proposed, and Calvert Cliffs additional nuclear unit in 2015.
Source: Maryland Public Service Commission, Princeton Energy Resources International

The dark green wedge portrays the capacity of current renewable energy generation (not including large hydro, which is portrayed separately) and known renewable energy additions between 2009 and 2018. All known significant renewable energy additions will likely come from wind. The light green wedge

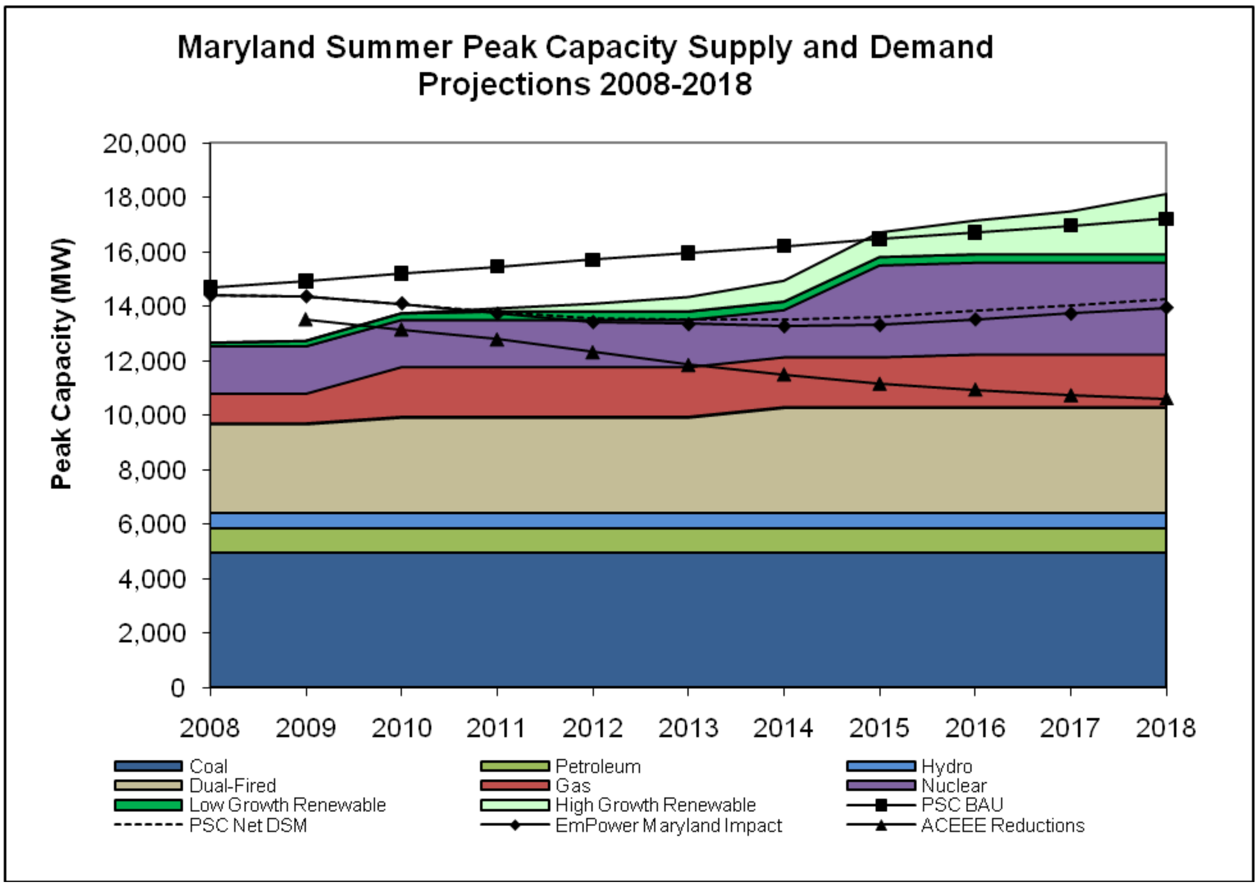
[37] PSC, Ten-Year Plan (2008-2017) of Electric Companies in Maryland, February 2009.

represents a high growth scenario for renewable energy – a growth scenario of more than 2,000 MWs by 2018 that could potentially be achieved if the state aggressively pursues untapped renewable energy sources.[38]

Exhibit 25 incorporates the capacity supply projection with four different capacity demand scenarios, represented by the horizontal and sloped lines. The "square" line, or "PSC BAU," demonstrates a high demand forecast that encompasses a "business as usual" approach as projected by the Maryland Public Service Commission.[39] The "dashed" line, or "PSC Net DSM," beneath the business as usual forecast represents the demand savings reflected by current DSM programs proposed (and in some cases underway) by the State's major investor-owned utilities. The "diamond" line represents the demand savings outlook if all of the EmPower Maryland goals are met. Finally, the "triangle" line displays the demand reductions that would occur if all of ACEEE's recommendations are enacted.

The deviation in these demand lines demonstrates the difference in forecasted capacity demand and supply. It is clear that the electric capacity needed in the State would vary greatly depending on the scenario utilized.

Exhibit 25



Source: Maryland Public Service Commission, EmPower Maryland legislation, ACEEE, Princeton Energy Resources International

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38 PERI estimate.

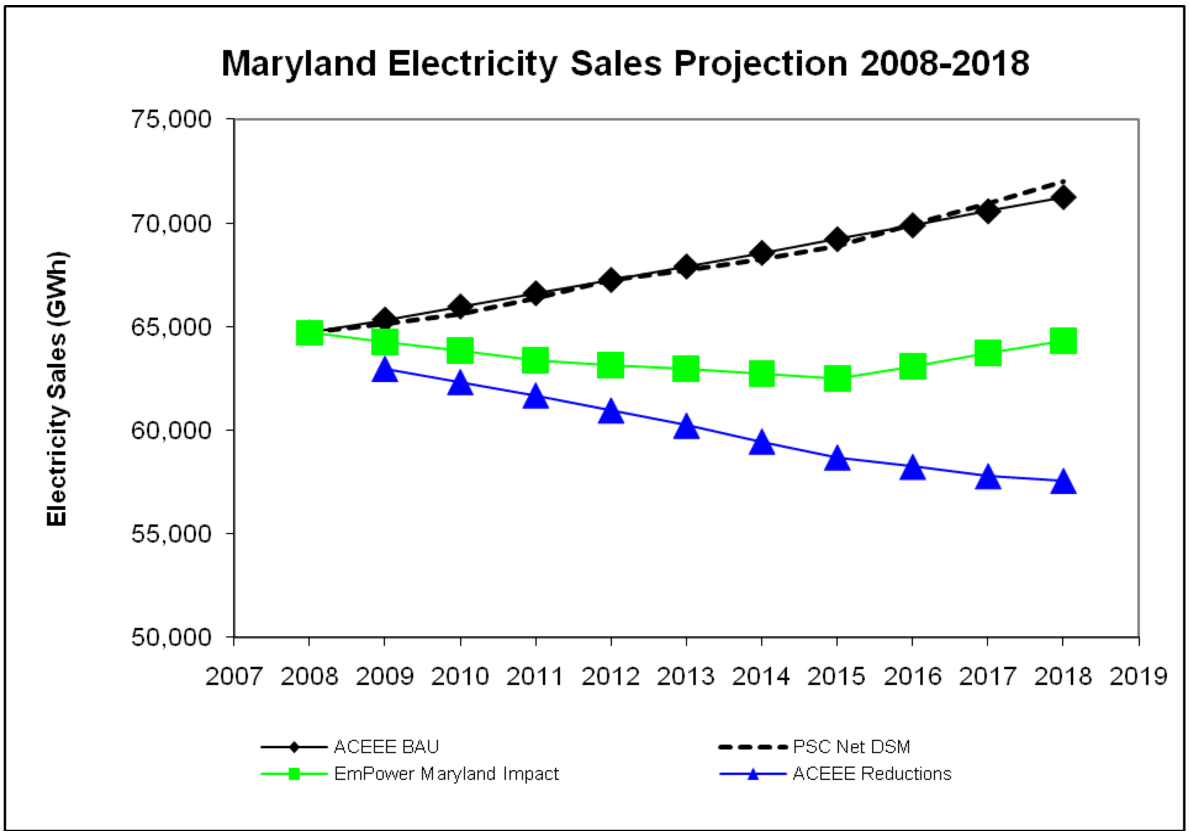
39 PSC, *Ten-Year Plan (2008-2017) of Electric Companies in Maryland*, February 2009.

5.4.2 Electricity Sales Projection

Exhibit 26 includes four different electricity sales projections for Maryland. The black "diamond" line, or "ACEEE BAU," represents a business-as-usual electricity use forecast based on projected average annual growth rate of 0.97% in the ACEEE's *Energy Efficiency: The First Fuel for a Clean Energy Future* report published in February 2008[40]; the starting value for the "ACEEE BAU" line is the Maryland PSC's Ten Year Plan's value for 2008.[41] The "dashed" line, or "PSC Net DSM," portrays the electricity use forecast included in the Maryland Public Service Commission's *Ten Year Plan (2008-2017) of Electric Companies in Maryland* published in February 2009. The green "square" line, or "EmPower Maryland Impact," portrays electricity consumption in Maryland if the electricity use reduction goals established by the EmPower Maryland legislation are achieved. Finally, the blue "triangle" line, or "ACEEE Reductions," displays the consumption reductions that would occur if all of ACEEE's recommendations are enacted.

According to the *Ten Year Plan (2008-2017) of Electric Companies in Maryland*, the consumption projection included in the report ("PSC Net DSM" line in Exhibit 26) includes the expected impact of utility companies' current demand side management programs. As is evidenced by the electricity use projection chart, these current projections do not point towards Maryland achieving its EmPower Maryland energy reduction goals.

Exhibit 26



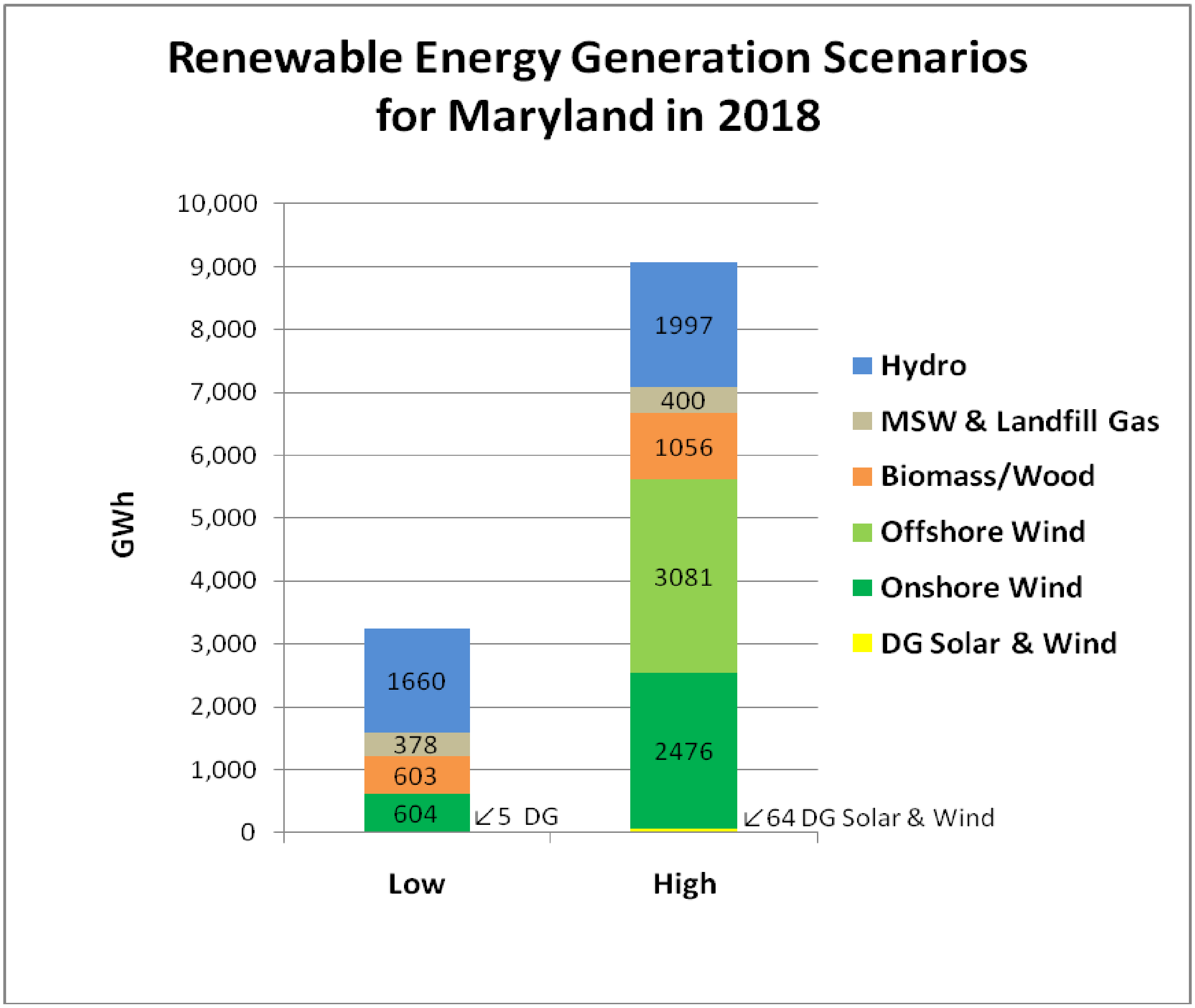
Source: Maryland Public Service Commission, EmPower Maryland legislation, ACEEE

[40] ACEEE, *Energy Efficiency: The First Fuel for a Clean Energy Future,* February 2008.
[41] PSC, Ten-Year Plan (2008-2017) of Electric Companies in Maryland, February 2009.

5.4.3 Renewable Electricity Projection

As portrayed in Exhibit 24, two growth scenarios for renewable electricity production are presented. Exhibit 27 portrays the projected mix of renewable electricity generation for both a high and a low growth scenario.[42] While either of these scenarios are possible, the high growth scenario will likely depend on policies designed to help offset the higher costs for renewable plants and to support broad development of these resources.

Exhibit 27



Note: MSW=Municipal Solid Waste; DG=Distributed Generation.
Source: Maryland Public Service Commission, EIA, Princeton Energy Resources International

Under the low growth scenario, 230 MW of currently proposed onshore wind energy will be added to Maryland's electricity generation mix. [43] These are projects currently in the permitting process. In this scenario, no other renewable energy generation capacity is projected to come online before 2018.

[42] PERI estimate (low scenario assumes that only projects currently in the PJM queue will be built).
[43] PERI estimate (high scenario assumes that new installations depend on currently available incentives, but that the RPS may not be fulfilled unless new incentives are added).

The high growth scenario assumes that Maryland aggressively pursues and develops all available forms of renewable electricity production. This scenario includes growth in all renewable electricity sources, including hydro, municipal solid waste (MSW) and landfill gas, wood and other biomass, both onshore and offshore wind, and distributed small wind and solar energy.

In the low growth scenario, the only significant difference between Maryland's renewable electricity production between 2009 and 2018 will be in the area of wind generation. The addition of 230 MW of onshore wind would mean that in 2018 approximately 19% of Maryland's renewable electricity generation would come from wind.[44] In terms of total renewables, the low case scenario would have Maryland providing approximately 6% (assuming EmPower Maryland is fully achieved) of a mandated 18% (by the year 2022) needed for the State's Renewable Portfolio Standard (RPS) by 2018.

In the high growth scenario, Maryland's renewable electricity generation picture would look very different from today. Most importantly, total renewable electricity generation would triple compared to the low growth scenario. Even though the high growth scenario entails increases in all forms of renewable electricity production, the majority of growth would come from onshore and offshore wind development. Under the high growth scenario, in 2018 approximately 61% of Maryland's renewable electricity generation would come from wind. The high growth scenario assumes that Maryland would have around 900 MW capacity of onshore wind, approximately 1,000 MW of offshore wind, and 50 MW of new solar capacity in 2018. In terms of total renewables, the low case scenario would have Maryland providing approximately 15% (assuming EmPower Maryland is fully achieved) of a mandated 18% (by the year 2022) needed for the State's RPS by 2018.

Maryland's RPS law specifies that all solar energy requirements must be met with resources within the State. To fulfill the 2.0% percent solar set-aside by 2022 would require the development of approximately 1,500 MW of solar capacity. Even the high growth scenario portrayed in Exhibit 27 falls short of this goal.

5.5 The Future

Maryland's energy future will include many options. Net imports will likely continue, although distributed generation, combined heat and power, aggressive energy conservation and efficiency, improved transmission and distribution, and development of renewable resources in-state could lessen the economic impact of these imports. While the current U.S. economy is tempering our energy demands, future growth in the economy and concurrent population growth, could create energy growth once again. The question to be asked is what policies or actions are needed to meet our energy goals and to secure affordable, reliable and clean energy for our future. Do we have adequate supplies? What do we need to do to increase Maryland supplies and move toward a more sustainable future? Are there specific actions that should be taken? The Maryland Energy Outlook (MEO) attempts to answer these questions.

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[44] PERI estimate (assumes that 240 MW of land-based projects and 1000 MW offshore are built).